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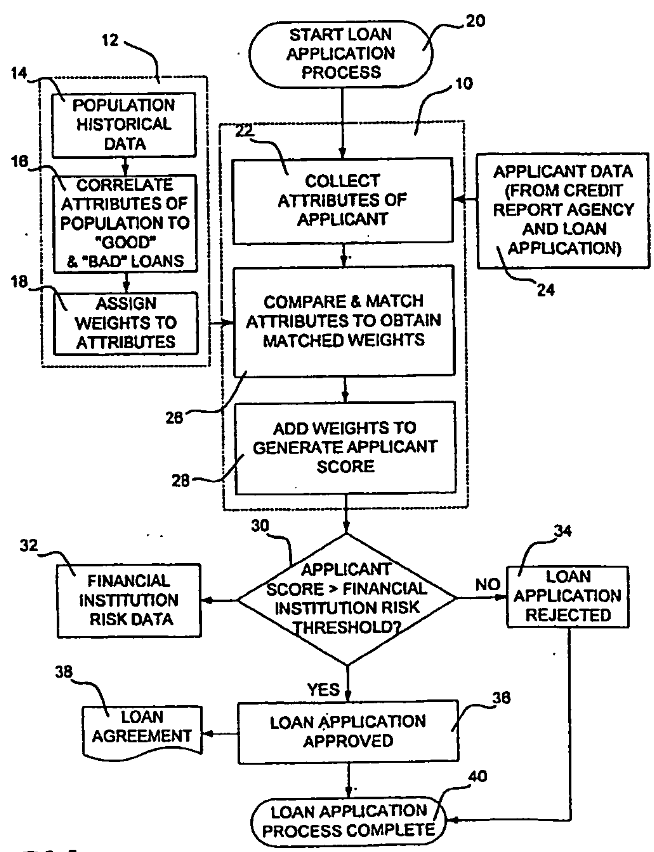
(57) Abstract

A system and method for generating data such as a forecast indicative of risk associated with an application for financial services and/or a portfolio of financial agreements for purposes of risk assessment and management (30). The method includes the basic step of generating a forecast of performance wherein the forecast comprises a series of discrete scenarios applied over a finite time line, using a template called an aging strip. Such a forecast is indicative of risk. The present invention is a significant improvement over the prior art in that it does not rely on the future to mirror the past, but rather uses historical experience to provide scenarios and associated probabilities to generate a forecast of performance.



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FINANCIAL FORECASTING SYSTEM AND METHOD FOR RISK ASSESSMENT AND MANAGEMENT

Field of the Invention

The present invention generally relates to risk analysis and management in the financial industry. Specifically, the present invention relates to systems and methods for performing risk assessment of financial service applications and risk management of financial portfolios.

Background of the Invention

As can be readily appreciated, the ability of a financial institution to become and remain a profitable entity is highly dependent on assessing and managing risks associated with its investments. In the financial industry, for example, wherein financial services comprise investments, it is critical to be able to accurately assess the credit worthiness of an individual applicant before a financial service (e.g., a loan or a line of credit) is extended to the applicant. If the credit worthiness of an individual applicant passes a threshold value, the application is accepted and the financial service is extended to the individual. As such, the threshold value may be used to control the level of risk associated with a financial institution's investments. If the credit worthiness is accurately measured and the threshold value is properly set, a financial institution is well equipped to prosper.

The conventional method for determining credit worthiness is called credit scoring. Credit scoring is premised on the idea that the recent past is an indicator of the near future. Credit scoring provides a method by which risk may be measured and quantified, and is primarily used for determining risk associated with credit applications, but is also used for determining collections strategies, determining credit limits, evaluating account renewal, authorizing transactions and developing marketing strategies. For purposes of illustration, the credit scoring method is discussed in the context of credit and loan applications.

Initially, the credit scoring process involves collecting historical data from a population of individuals relating to certain attributes of the individuals, for example, credit history, debts, assets, employment, and residence. These attributes are then correlated to "good" and "bad" loans. The definition of a "good" or "bad" loan varies

depending on the financial institution's use of the loan, but generally correlates to a profitable loan or a non-profitable loan, respectively. Weights are then assigned to the attributes as function of how significant an impact the attribute is perceived to have on the outcome of the loan as either a "good" or "bad" loan.

The next step in the credit scoring process involves correlating the attributes of an individual applicant to attributes from the population to generate a set of matched attributes. The corresponding weight for each matched attribute is added to obtain a score for the individual applicant. The score is a quantification of risk associated with the application of the individual, and represents the completion of the risk assessment process using the credit scoring method.

If the score is less than the threshold value as set by the financial institution, the application is rejected. If, on the other hand, the score is greater than the threshold value, the application is approved. An approved application paves the way for an agreement between the financial institution and the individual. The agreement provides a loan or line of credit to the individual from the financial institution in exchange for a promise to repay according to specified terms (period, interest rate, etc.). The agreement also represents a discrete investment to be added to the financial institution's portfolio.

Because the credit scoring method is premised on the idea that the recent past is a predictor of the near future, the near future must be a mirror image of the recent past. Variables from a past time period are associated with good and bad loans and are assumed to have the same association in a future time period of equal duration. The accuracy of the credit scoring method is limited to the accuracy of this assumption. The accuracy of this assumption, in turn, is limited to the extent that the future holds the exact same variable association as the past. In other words, the accuracy of the credit scoring method is limited by the assumption that the future is a static replication of the past.

The credit scoring method also treats individual applicants as static objects that are assigned a score corresponding to their credit worthiness at the time of the application. In reality, however, individual applicants are dynamic in that their attributes change with time and thus their credit worthiness changes with time. Thus,

the accuracy of the credit scoring method is also limited because it fails to treat individual applicants as dynamic entities.

In sum, the accuracy of the credit scoring method is limited because it fails to treat individual applicants as dynamic entities and it fails to treat time as a dynamic function.

Summary of the Invention

The present invention recognizes that individuals are dynamic entities wherein their attributes change with time and that the future will inevitably present different events occurring at different times than in the past. In so recognizing, the present invention provides a system and method for generating data such as a forecast indicative of risk associated with an application for financial services (e.g., loans, lines of credit, etc.) for purposes of application decision making. Similarly, as applied to a portfolio of financial agreements (e.g., mortgages, credit agreements, etc.), the present invention provides a system and method for generating data such as a forecast indicative of risk associated with the portfolio for purposes of portfolio risk management.

The present invention is a significant improvement over the prior art in that it does not rely on the future to mirror the past, but rather uses historical experience to provide scenarios and associated probabilities to generate a forecast of performance. In terms of risk assessment, the present invention provides a method for generating data indicative of risk associated with an application for a financial service by an applicant. The method includes the basic step of generating a forecast of performance of the applicant wherein the forecast comprises a series of discrete scenarios applied over a finite time line, using a template called an aging strip. Such a forecast is indicative of risk associated with the application. The forecast may be compared to a risk threshold of the financial institution and the application may be accepted or rejected if the forecast is greater than or less than the risk threshold. Preferably, a plurality of forecasts are generated including an optimistic forecast, a pessimistic forecast and a neutral forecast.

The series of discrete scenarios are selected from a set of applicant scenarios which are generated based on attributes of the applicant. The series of discrete scenarios may also include population scenarios which are generated based on

attributes of a population of individual applicants and matched to the applicant under consideration. The series of discrete scenarios may further include global scenarios which are generated based on attributes affecting the entire population. The order of precedence is preferably applicant scenarios, population scenarios and global scenarios because of the respective impact on the forecast.

The process of generating a forecast involves modifying an applicant performance curve. The applicant performance curve comprises applicant energy as a function of time having an initial energy, and may also be expressed in terms of an algorithm or a series of algorithms. The curve is modified by applying the series of discrete scenarios points in time based on the probability of occurrence of each discrete scenario at each point in time. The energy at each point in time changes in an amount corresponding to the magnitude and direction of the discrete scenario applied at the point in time to obtain a modified performance curve. The modified performance curve essentially comprises the forecast of performance, which is indicative of risk.

The process of generating applicant scenarios involves sampling the applicant data for changes in the attributes as a function of time to generate applicant sequences. Each sequence is characterized as a positive, negative or neutral influence. A probability of occurrence and an intensity is calculated for each sequence. The magnitude, direction and probability of occurrence of each applicant scenario correlates to the intensity, influence and probability of occurrence of each applicant sequence, respectively.

The process of generating population scenarios involves sampling the population data for changes of the attributes as a function of time to generate population sequences. The population sequences are correlated to successful loans and failed loans to generate population sequences having a positive influence and a negative influence, respectively. A probability of occurrence and an intensity is calculated for each population sequence. The population sequences are then sampled for common patterns to generate stable population sequences. The stable population sequences are then classified based on association with class attributes of the population to generate classes of stable population sequences having class attributes. The class attributes are matched to applicant attributes to generate matched population

sequences applicable to the applicant. The magnitude, direction and probability of occurrence of each population scenario correlates to the intensity, influence and probability of occurrence of each matched population sequence, respectively.

In terms of risk management, the present invention provides a method for generating data indicative of risk associated with a portfolio of financial service agreements. The method includes the basic step of generating a forecast of performance of the portfolio wherein the forecast comprises a series of discrete scenarios applied over a finite time line, using a template called an aging strip. Such a forecast is indicative of risk associated with the portfolio. The series of discrete scenarios is applied to a set of individual forecasts of performance for each agreement or a class of agreements in the portfolio to generate the portfolio forecast. The series of discrete scenarios are selected from a set of global scenarios generated from global attributes affecting all agreements within the portfolio. The global data may include macro economic information and or financial institution information.

Important to the risk management process is the step of identifying steady state conditions within the portfolio. More significant to the process is the step of identifying a steady state condition of the entire portfolio, referred to as the transient equilibrium point of the portfolio. This may be accomplished by synchronizing the agreements within the portfolio as a function of time. The portfolio characteristics may then be identified at the steady state conditions and the transient equilibrium point.

Although the present invention is described above as a method of generating data indicative of risk, those skilled in the art will recognize that this method may be implemented, for example, in a data processing system (e.g., a personal computer, a computer network, etc.) or in executable instructions (e.g., a software application, regardless of language) for a data processing system, or in a combination thereof, each having a number practical applications. Such practical applications include, but are not limited to risk assessment and decision making for financial service applications and risk assessment and management for financial agreement portfolios. Those skilled in the art will recognize that other practical applications are suitable for the present invention although not specifically described herein.

Brief Description of the Drawings

FIG. 1 is a flow chart illustrating the credit scoring method of the prior art;

FIG. 2 is a flow chart illustrating a computer implemented method for generating data indicative of risk associated with an application for financial services in accordance with an exemplary embodiment of the present invention;

FIG. 3 is a flow chart illustrating a computer implemented method for generating scenarios for use in the method shown in FIG. 2;

FIG. 4 is a flow chart illustrating a computer implemented method for generating an applicant forecast for use in the method shown in FIG. 2;

FIG. 5 is a flow chart illustrating a computer implemented method for generating applicant scenarios for use in the method shown in FIG. 3;

FIG. 6 is a flow chart illustrating a computer implemented method for generating population scenarios for use in the method shown in FIG. 3;

FIGS. 7A-7C illustrate the method of applying a series of discrete scenarios to a finite time line using a template called an aging strip to provide an optimistic forecast;

FIGS. 7D-7F illustrate the method of applying a series of discrete scenarios to a finite time line using a template called an aging strip to provide a pessimistic forecast;

FIG. 8 is a flow chart illustrating a computer implemented method for generating data indicative of risk associated with a portfolio of financial service agreements in accordance with an exemplary embodiment of the present invention;

FIG. 9 is a flow chart illustrating a computer implemented method for generating a portfolio forecast for use in the method shown in FIG. 8; and

FIG. 10 is a schematic diagram illustrating a computer system for generating data indicative of risk associated with an application for financial services and/or a portfolio of financial service agreements in accordance with an exemplary embodiment of the present invention.

Detailed Description of the Drawings

The following detailed description is presented largely in terms of methods, algorithms, and symbolic representations of operations on data bits within a computer memory. These methods, algorithmic descriptions and symbolic representations are

the means used by those skilled in the arts to most effectively convey the substance of their work to others skilled in the art.

A method or algorithm is herein, generally, conceived to be a self-consistent sequence of steps leading to a desire result. These steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It is often convenient, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, data, or the like. It should be kept in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities.

Furthermore, the manipulations performed are often referred to in terms such as adding, comparing, generating, modifying, applying, correlating, calculating, sampling, and the like, which are commonly associated with mental operations performed by human operators. No such compatibility of a human operator is necessary, or desirable in most cases, in any of the operations described herein. Specifically, the methods and operations contemplated herein are machine or computer operations. Useful machines for performing the operations and methods of the present invention include general-purpose digital computers or other similar devices.

In all cases, it should be kept in mind the distinction between the method operations in operating a computer and the method of computation, itself. The present invention relates to method steps for operating a computer in processing electrical or other (e.g., mechanical, chemical, magnetic) physical signals to generate other desired physical signals.

The present invention also relates to an apparatus for performing these methods and operations. This apparatus may be specially constructed for the required purposes or it may comprise a general-purpose computer selectively activated or reconfigured by a computer program stored in the computer. The algorithms and methods presented herein are not inherently related to a particular computer system or other apparatus. Various general-purpose computer systems may be used with computer programs written in accordance with the teachings of the present invention,

or it may prove to be more convenient to construct a specialized apparatus to perform the required method steps. The required structure for such machines or computers will be apparent to those skilled in the art in light of the description given below.

In sum, the present invention is preferably implemented for practice by a computer, e.g., a source code expression of the present invention is input to the computer to control operations therein. It is contemplated that a number of source code expressions, in one or many computer languages, may be utilized to implement the present invention. A variety of computer systems can be used to practice the present invention, including, for example, a personal computer, an engineering workstation, an enterprise server, etc. The present invention, however, is not limited to the practice on any one particular computer system, and the selection of a particular computer system can be made for many reasons.

The following detailed description should be read with reference to the drawings in which similar elements in different drawings are numbered the same. The drawings, which are not necessarily to scale, depict illustrative embodiments and are not intended to limit the scope of the invention.

Refer now to Figure 1, which shows a flow chart illustrating the credit scoring method 10 of the prior art. The credit scoring method 10 is the conventional method for determining credit worthiness of an applicant who is applying for a financial service such as a loan or line of credit. For purposes of describing the credit scoring method 10 herein, a loan is used as the financial service.

Prior to beginning the credit scoring method 10, a number of background processes 12 are performed. The background processes 12 begin with the step 14 of obtaining credit history data of a population. The credit history data be obtained from a credit bureau or a financial institution. The historical data relates to certain attributes of individuals within the population. For example, the attributes may include information related to debts, assets, employment, and residence. The next step 16 is to correlate the attributes to "good" and "bad" loans. The definition of a "good" or "bad" loan varies depending on the financial institution's use of the loan, but generally correlates to a profitable loan or a non-profitable loan, respectively. The next step 18 is to assign weights the to population attributes. Weights are assigned to the attributes of the population as a function of how much of an impact the particular

attribute is perceived to have on the outcome of the loan as either a "good" or "bad" loan. Thus, a collection of population attributes and corresponding weights are provided by performing the background processes 12. Once the background processes 12 are complete, the credit scoring method 10 may be applied to a loan application.

The initial step 22 in the credit scoring process is to collect attributes 22 of the applicant. The attributes of the applicant are obtained from applicant data 24 which, in turn, is obtained from a credit report agency and/or the loan application. The next step 26 is to compare and match attributes. Specifically, the attributes of the applicant are compared to the attributes of the population to obtain a set of matched attributes with corresponding weights. The next step 28 is to add the corresponding weight for each matched attribute to obtain a score for the individual applicant. The score is a qualification of risk associated with the individual and completes the credit scoring process 10.

The next step 30 in the loan application process is to compare the score of the applicant to a risk threshold of the financial institution considering the application. The risk threshold of the financial institution is obtained from financial institution risk data 32. If the score of the applicant is less than the risk threshold of the financial institution, the loan application is rejected 34. If the applicant score is greater than the risk threshold of the financial institution, the loan application is approved 36. If the loan application is approved, a loan agreement 38 may be executed between the applicant and the financial institution. After a decision has been reached with regard to the application, the loan application process is complete 40.

As mentioned previously, the credit scoring method 10 is premised on the theory that the recent past is a predictor of the near future. However, the accuracy of the credit scoring method 10 is limited to the extent that the future holds the exact same variable association (i.e., correlation of attributes to "good" and "bad" loans) as in the past.

By contrast, the present invention does not rely on the future to mirror the past, but rather utilizes historical experience to provide scenarios and associated probabilities to generate a forecast of performance. The forecast of performance, whether applied to an application for financial services or a portfolio of financial

agreements, is indicative of risk. A financial institution may utilize such a forecast to render a decision and take action with regard to the application or portfolio, with a higher degree of accuracy and confidence than with prior art methods.

Refer now to Figure 2, which shows a flow chart illustrating a computer implemented method 200 for generating data indicative of risk associated with an application for financial services in accordance with an exemplary embodiment of the present invention. The method 200 involves the basic steps 60, 70 of generating a forecast of performance of the applicant utilizing a series of discrete scenarios. The step 70 of generating the applicant forecast requires the prior step 60 of generating scenarios from data 100. Data 100 may comprise data specific to the applicant, data specific to applicants within a population, and/or data applicable to an entire population.

Once the applicant forecast has been generated, a decision 80 may be rendered with regard to the application as to whether to accept or reject the application. The decision to accept or reject the application involves the steps of comparing the forecast to a risk threshold of the financial institution and accepting the application if the forecast is greater than or otherwise better than the risk threshold. Conversely, the application may be rejected if the forecast is less than or otherwise worse than the risk threshold. Risk threshold, as used herein, is more likely to be stated in terms of a plurality of variable limitations, as opposed to a single discrete value. The risk threshold of the financial institution may be set by the financial institution based on financial institution risk experience. If the application is accepted, a financial service agreement 82 may be entered into between the applicant and the financial institution.

Refer now to Figure 3, which shows a flow chart illustrating in detail the step 60 of generating scenarios for use in the method 200 shown in Figure 2. The step 60 of generating scenarios may involve three discreet subprocesses, namely the step 110 of generating applicant scenarios, the step 130 of generating of population scenarios, and the step 150 of generating global scenarios, in order of importance.

The generation of applicant scenarios utilizes applicant data 102, which may be obtained, for example, from the financial service application or from a credit bureau. The applicant data 102 is indicative of attributes of the applicant. These attributes include, for example, age, marital status, income, educational experience,

professional experience, assets, liabilities, etc., applicable to the applicant. The generation of applicant scenarios is discussed in more detail with reference to Figure 5.

The generation of population scenarios requires the use of both applicant data 102 and population data 104, because a correlation must be established between applicant attributes and population attributes in order to obtain matched scenarios. Population data 104 may be obtained, for example, from a financial institution's historical data. The population data 104 is indicative of attributes of a plurality of individuals within the population. For the generation of population scenarios, the atomicity of the individuals within the population is violated. The atomicity or independence of the individuals within the population is violated for purposes of sampling attributes and generating sequences discussed hereinafter. Thus, the population data 104 is essentially turned on its side and treated as a pool of continuous variables during this process. The population attributes are the same as the applicant attributes described above, except the population attributes are applicable to a plurality of applicants within the population, rather than a single individual. The generation of population scenarios and the use of population data 104 is particularly important for weak experience applicants. In other words, if insufficient applicant data 102 is available, the population data 104 becomes more important in generating the applicant forecast. The generation of population scenarios is described in more detail with reference to Figure 6.

The generation of global scenarios requires the use of global data 106 which may be obtained, for example, from the financial institution and from general economic data commonly available to the public. The global data 106 is indicative of global attributes affecting all applicants within the population. In other words, the global attributes are common to each and every applicant within the population. As used herein, global data or attributes include two distinct types: global to an individual application but internal to the financial institution and global to the financial institution. Applicant scenarios primarily use the first while risk management process uses the later. The risk management process is explained later in this document. Examples of global attributes include, for example, increases in the prime rate,

general macro-economic trends, general political trends having economic impact, financial institution policies, etc.

After the steps 110, 130, 150 of generating applicant scenarios, population scenarios and global scenarios, respectively, the next step is to combine the scenarios to obtain a set of scenarios 62. Although the set of scenarios 62 preferably includes all three types (applicant, population and global) of scenarios, the set may merely comprise a subset of the three. Specifically, the set of scenarios 62 may only comprise applicant scenarios, or a combination of applicant scenarios and population scenarios.

Each scenario includes a probability of occurrence and an effect on future performance of the applicant. Specifically, each scenario generated has a probability of occurrence at any given point in time. This probability of occurrence should not be confused with the probability of a scenario being added to the set of possible scenarios 62. This later probability is indicative of the accuracy of the scenario generation process and indirectly the accuracy of the forecast. In addition, each scenario has an influence or an effect on future performance that may be characterized as a positive influence, a negative influence, or a neutral influence.

Refer now to Figure 4, which shows a flow chart illustrating in detail the step 70 of generating a forecast for use in the method 200 shown in Figure 2. The process of generating an applicant forecast begins with the step 72 of generating an initial performance curve. The initial applicant performance curve provides applicant energy as a function of time. Energy, in this context, is used figuratively, not literally. The initial and modified applicant performance curves may be linear or non-linear, and further, may be continuous or discontinuous. For purposes of illustration, the initial applicant performance curve is assumed to be a linear continuous curve having an initial energy and an initial decay rate or slope. The initial energy and the initial decay rate may be selected based on applicant attributes at the time the application is filed. An applicant with a large number of positive attributes may have a high initial energy and a slow decay rate. Conversely, an applicant with a large number of negative attributes may have a low initial energy and a fast decay rate.

After generating the initial applicant performance curve, the next step 74 is to apply a series of discreet scenarios to the performance curve. The series of discreet

scenarios are applied to the performance curve at points in time based on the probability of occurrence of each discreet scenario at each respective point in time. Specifically, the application of a scenario at a given point in time, i.e., the timing, may determined using a nearest neighbor model which is based in part on the probability of occurrence of the scenario. The nearest neighbor model may be described as the process of creating a multi-dimensional matrix or hyper-cube or non-directional graphs to find the most probable arrangement and timing of scenarios. The edges of the graphs contain characteristics such as delay from previous neighbor, confidence level as well as any other optimization goals that the financial institution desires. By selecting a proper set of scenarios by following the best performance fit along the edges or moving to the nearest or best neighbor, one can optimize the overall goal of the forecasting process. When the delays reach the end or total of the time utilized on the aging strip, the process stops.

The energy value or the slope of the curve changes at each point in an amount corresponding to the magnitude and direction of the scenario applied at each point. After the scenarios have been applied, the result is a modified performance curve comprising a forecast of performance 76. The generation of the performance curve and the application of the scenarios thereto are discussed in more detail with reference to Figures 7A - 7F.

It is preferable to obtain more than one forecast of performance in order to demonstrate circumstances under which the applicant will succeed and fail. Accordingly, if the decision 78 is rendered to generate an additional applicant forecast, the scenario selection is modified 73 and the new selection of scenarios is reapplied 74 to generate another forecast of performance 76. Modification of the scenario selection may be performed to generate an optimistic forecast and a pessimistic forecast. Alternatively, the modification of the scenario selection may be performed to obtain an optimistic forecast, a pessimistic forecast, and a neutral forecast. In some circumstances, however, it may not be possible to obtain an optimistic forecast or a neutral forecast if the applicant has a large number of negative attributes (i.e., not credit worthy). In such circumstances, the modification of the scenario selection may result in a plurality of pessimistic forecasts.

The modification of the scenario selection may be accomplished by, for example, increasing or decreasing the probability of occurrence of each scenario, increasing or decreasing the magnitude of each scenario, changing the direction of each scenario, and/or changing the timing. If a pessimistic forecast is desired, the probability of occurrence of scenarios having a negative direction or influence may be increased. Similarly, the magnitude of each scenario having a negative influence or direction may be increased. Alternatively, the timing may be changed such that the negative scenarios occur earlier in time and the positive scenarios occur later in time.

In order to generate an optimistic forecast, the probability of occurrence of discreet scenarios having a positive influence or direction may be increased. Similarly, the magnitude of each scenario having a positive influence or direction may be increased. Alternatively, the timing may be changed such that the positive scenarios occur earlier in time and the negative scenarios occur later in time.

The net effect of these changes is to modify the selection or character of the scenarios applied to the performance curve. By generating multiple forecasts with optimistic and pessimistic outlooks, it is possible to understand under which circumstances a particular applicant will succeed or fail, and thereby assist in the decision as to whether or not to accept or reject the application. Alternatively, the forecasts may form the basis to modify the terms under which a financial service agreement will be entered into.

Refer now to Figure 5, which shows a flow chart illustrating in detail the step 110 of generating applicant scenarios for use in the method 60 illustrated in Figure 3. The process of generating applicant scenarios begins with the step 112 of sampling applicant data 112. The applicant data 102 is sampled for changes in applicant attributes as a function of time to generate applicant sequences 114. The applicant sequences 114 represent changes in the applicant attributes as a function of time. Each sequence within the set of applicant sequences 114 is then characterized 116 as a positive, negative, or neutral influence. The sequence characterization is based on the effect that each sequence is perceived to have on the economic welfare of the particular applicant. For example, a change in employment status wherein the applicant is laid-off will have a negative influence. By contrast, a change in employment wherein the applicant is promoted with a pay raise will have a positive

influence. Accordingly, each change in an applicant attribute is characterized according to its economic impact on the applicant.

The next step 118 is to calculate a probability of occurrence for each sequence. The probability of occurrence may be calculated by taking the ratio of the number of times the sequence was part of the group of loans that showed the desired outcome and the total number of applicants in this group. Hence in a group of 10,000 loans, if a specific scenario existed 9000 times the probability is 0.9.

The next step 120 is to calculate an intensity for each sequence. The intensity corresponds to the amount of influence the particular sequence will have on the economic welfare of the applicant. For example, a sequence such as a change in marital status may have a significant effect on the economic welfare of the applicant, and therefore have a relatively have a large intensity. Conversely, a sequence such as a small change in net fraction revolving burden (NFRB) may have little effect on the economic condition of the applicant, and therefore have a relatively low intensity.

The intensity for each sequence may be calculated by establishing a gradation among outcomes and then representing the change on a fixed scale throughout the forecast process. Intensity is a path dependent quantity. Within the scope of an applicant's past history, intensity is calculated by grading the various positive and negative changes internal to the applicant. The sequences that are related to these changes are then assigned a relative intensity depending on the severity of the change. Each financial institution's risk management requirements determine the gradation of the outcomes. Usually the profitability function of an institution is used to grade the various outcomes and relate well to the intensity of the scenarios.

The intensity, influence, and probability of occurrence of each applicant sequence corresponds to the magnitude, direction, and probability of occurrence of each applicant scenario such that a set of applicant scenarios 122 may be generated from the set of applicant sequences 114. This completes the step of generating applicant scenarios 110.

Refer now to Figure 6, which shows a flow chart illustrating in detail the step 130 of generating population scenarios for use in the method 60 shown in Figure 3. The process for generating population scenarios begins with the step 132 of sampling the population data 104. Specifically, the population data 104 is sampled for changes

in the population attributes as a function of time to generate population sequences 134. The population sequences 134 represent changes in the population attributes as a function of time. The population sequences are then correlated 136 to successful loans and failed loans. The step 136 of correlating the population sequences generates population sequences having a positive influence or a negative influence corresponding to successful loans or failed loans, respectively.

The next step 138 is to calculate the probability of each population sequence. The probability of occurrence may be calculated as discussed previously with regard to applicant sequences but utilizing different data sets as discussed herein.

The next step 140 is to calculate an intensity for each population sequence. The intensity may be calculated as discussed previously with regard to applicant sequences but utilizing different data sets as discussed herein.

The probability of occurrence for each population sequence represents the likelihood of the particular sequence occurring at discreet points in time. Similarly, the intensity for each population sequence correlates to the amount of influence the population sequence has on the economic welfare of the individuals within the population.

The next step 141 is to sample the population sequences for common patterns to generate stable population sequences 142. The stable population sequences represent sequences which occur on a regular basis within the population. The sampling process 141 eliminates sequences which are unique to particular individuals within the population and are thus relatively uncommon sequences not applicable to other individuals within the population.

The stable population sequences are then classified 143 to generate classes of stable population sequences 144 having class attributes. The stable population sequences are classified based on association with class attributes of the population. Class attributes comprise a collection of population attributes common to a group of individuals within the population. For example, a class attribute may comprise single males professionally employed for five years or less. This class attribute corresponds to a class of individuals within the population.

The class attributes are then matched 145 or otherwise correlated to the applicant attributes to generate matched population sequences 146 applicable to the

particular applicant under consideration. Specifically, the applicant under consideration may fall into one or more classes as defined by the class attributes that match the applicant's attributes. The matched classes, in turn, have corresponding stable population sequences which may then be matched to the applicant to generate matched population sequences 146. The intensity, influence, and probability of occurrence of each matched population sequence correlates to the magnitude, direction, and probability of occurrence of each population scenario 147. This completes the step of generating population scenarios 130.

Although not shown, the generation of global scenarios is similar to the generation of applicant scenarios, and is based on sampling global data indicative of global attributes for changes in the global attributes as a function of time to thereby generate global sequences. Each global sequence has an intensity, an influence on applicant welfare, and a probability of occurrence, which correlate to a magnitude, a direction and a probability of occurrence of each global scenario.

A method of mathematically representing scenarios and generating sequences is as follows. A scenario may be mathematically described by Equation 1:

Eq. 1 $$\text{Scenario} = \{I_d, \langle D_s, P_s, Eff_s, \{[\langle Ds_{ij}, S_{ij}, E_{ij}\rangle, \langle P_{ij}, G_j\rangle], \ldots\}, \{E_1, E_2, \ldots\}\rangle\}$$

Where:

I_d is the user defined identification of the scenario (name or number);

D_s is the overall std delay;

P_s is the probability of occurrence of scenario;

Eff_s is the overall effect of scenario as a vector term;

Ds_{ij} is the delay when the predecessor scenario S_{ij} is used;

S_{ij} is the predecessor scenario;

E_{ij} is the effect when placed after S_i

P_{ij} is the probability of placement after scenario (cumulative effect of decay accuracy);

G_j is the goal represented by this combination; and

$E_1, E_2 \ldots$ are events that are part of the scenario.

Each event (E), in turn, may be expressed by Equation 2:

Eq. 2 $E = \langle \delta, E_{2e}, P_{ei} \rangle$

Where:

δ is the delay from the preceding event;

E_{2e} is the effect of the event; and

P_{ei} is the probability of occurrence of the event.

Note that events (E) are independent of the goal (G) and that the scenario is goal (G) dependent. Also note that the probability P_s is the overall probability of occurrence of the scenario and does not effect the accuracy of the inference. However, P_{ij} is goal oriented and will affect the accuracy of the inference.

These mathematical descriptions may be used to generate 60 a set of scenarios 62 as discussed with reference to Figures 3, 5 and 6. Subsequently, an applicant forecast 76 may be generated 70 as discussed with reference to Figures 4 and 7A-7F using the aging strip method described.

An anchor scenario may be used as a starting scenario. An anchor scenario is selected from individual or class scenarios. If the applicant's individual data produced a very high probability scenario (i.e., greater than a user defined threshold), then the highest probability scenario is used as the anchor scenario. If not, the anchor scenario of the highest-class match is used as the anchor scenario. Note that it is possible to have several anchors. This simply means that several initial paths may be plotted on the aging strip.

Once an anchor is selected, the entire set of scenarios is searched to find all possible scenarios that follow the anchor towards the user defined goal criteria (optimistic, pessimistic etc). The best possible scenario is then selected to follow the anchor. It is preferable to minimize the reduction in accuracy between interations and have the highest probability of accuracy as the two main criteria for selecting the best scenario. However, a user may define other criteria for best follower association. Once the set of follower scenarios is selected, the process is repeated – i.e., the

followers now become leaders and a new set of followers is selected. This process continues until one or more termination conditions are reached. The most common termination condition is the overall cumulative accuracy of the inference. When this accuracy reaches a value below the user defined acceptable value, the process of sequencing scenarios is complete. Such a goal oriented sequence of scenarios is now applied to or becomes an aging strip as discussed with reference to Figures 7A-7F.

Refer now to Figures 7A through 7F, which illustrate the process 70 of generating an applicant forecast by the applying a series of discreet scenarios to a finite timeline using a template called an aging strip (energy vs. time graph). Specifically, Figures 7A through 7F graphically illustrate the process 70 for generating an applicant forecast as discussed with reference to Figures 2 and 4. Figures 7A through 7C illustrate an optimistic forecast, whereas Figures 7D through 7F illustrate a pessimistic forecast. This graphic illustration is for demonstrative purposes only and those skilled in the art will readily recognize that the curves, vectors, and manipulations thereof may be expressed in terms of one or more of algorithms.

With specific reference to Figure 7A, an initial applicant performance curve 210 is provided comprising applicant energy (E) as a function of time (t). The initial applicant performance curve 210 may be expressed as a continuous linear or non-linear algorithm, or a discontinuous series of linear or non-linear algorithms. For purposes of illustration only, the initial applicant performance curve 210 is shown as a continuous linear curve having an initial energy and an initial decay rate. The initial applicant performance curve 210 typically decays from its initial energy to zero energy in a finite time period, but may also increase or remain steady, depending on the attributes of the particular applicant. The initial applicant performance curve 210 illustrated in Figure 7A represents the performance of the applicant assuming no occurrence of scenarios, positive or negative, occur during the time period illustrated.

Figure 7B illustrates the application of a series of discreet scenarios 212, 214, 216, and 218 at discreet points in time along the finite timeline. The initial applicant performance curve 210 is shown in phantom. Figure 7B illustrates the discreet scenarios 212, 214, 216, and 218 as vectors placed at specific points on the time line based on the probability of occurrence of each scenario at each point in time. The

magnitude of each scenario is reflected by the height of the vector, and the influence of each scenario is reflected by the direction of the vector.

Scenario 212 illustrates a scenario having a negative influence with a moderate magnitude, scenario 214 illustrates a scenario having a positive influence with a large magnitude, and scenarios 216 and 218 illustrate scenarios having a negative influence with a relatively small magnitude. An example of scenario 212 may be a change in residence wherein the applicant encounters an increase in monthly mortgage payments. An example of scenario 214 may be a change in employment status wherein the applicant receives a promotion and a corresponding substantial increase in income. An example of scenarios 216 and 218 include a sequential occurrence of two increases in NFRB. The probability of an occurrence, magnitude, and direction of each scenario 212, 214, 216, and 218 illustrated in Figure 7B are merely illustrative, as a plethora of scenarios with various probabilities, magnitudes and directions are possible. Further, the scenarios may be applicant scenarios, population scenarios, global scenarios, a combination thereof, or a subset thereof.

Figure 7C shows the discreet scenarios 212, 214, 216, and 218 applied to the initial performance curve 210 (shown in phantom) resulting in a modified performance curve 230. The series of discreet scenarios 212 - 218 are applied to the initial performance curve 210 at points in time based on the probability of occurrence of each discreet scenario at each point in time. In this illustration, the slope at each point in time changes in an amount corresponding to the magnitude and direction of the discreet scenario applied thereto. Alternatively, the energy at each point in time may be changed in an amount corresponding to the magnitude and direction of each discreet scenario applied thereto. In either case, a modified performance curve 230 is obtained. The modified performance curve 230 comprises the forecast 76 of applicant performance referred to in Figure 4. In this particular example, the modified performance curve 230 remains positive for the duration of the financial service agreement, and thus is an optimistic forecast.

Applying the discreet scenarios 212 - 218 to the initial performance curve 210 may be accomplished by simple vector addition or by other mathematical means. For example, a series of partial differential equations representing the change at each discrete point may be solved to produce the net change in the energy of the applicant

over time. In the circumstance where more then one scenario is applied at the same discrete time slot the equations are either solved simultaneously to produce a single equation or the vectors of the various scenarios are added to produce a single net effect vector at the a point in time. The net effect vector then becomes a single partial differential equation that is applied sequentially. It is possible to simply provide vector additions of all the scenarios. The differential equation approach is more versatile and allows for better flexibility by allowing us to vary the rate of change in terms of the variables or events individually.

Refer now to Figures 7D through 7F, which illustrate a pessimistic forecast of applicant performance. As with the optimistic forecast illustrated in Figures 7A through 7C, an initial applicant performance curve 210 is provided having an initial energy and an initial decay rate or slope. The primary difference between the optimistic forecast illustrated in Figures 7A through 7C and the pessimistic forecast illustrated in Figures 7D through 7F is the order of occurrence of the scenarios 212 - 218. Specifically, as seen in Figure 7E, each of the scenarios having a negative influence, namely scenarios 212, 216, and 218, occur early along the finite time line, and the only scenario having a positive influence, namely scenario 214, occurs late along the finite timeline. The result is illustrated in Figure 7F by the modified performance curve 220. As can be readily appreciated, the early occurrence of the scenarios having a negative influence 212, 216, and 218 results in a modified performance curve 220 reaching a zero energy level at a relatively early stage, most likely prior to the term of the financial service agreement. Because the energy reaches zero prior to the occurrence of the scenario 214 having a positive influence, the occurrence of scenario 214 is immaterial to the pessimistic forecast.

As can be seen by the examples provided in Figures 7A through 7F, the same scenarios occurring at different points in time may have a dramatically different outcome on the forecast of performance of the applicant. This dramatic difference illustrates the desirability of generating multiple forecasts including at least one optimistic forecast, one pessimistic forecast, and a neutral forecast. Such forecasts may be generated using the methods described previously. Each of these forecasts, taken alone or in combination, is indicative of risk associated with the applicant. A financial institution may thereby determine whether to accept or reject a particular

financial service application or modify the terms under which a financial service agreement is entered into. This financial forecasting tool represents a significant improvement over the prior art in that it does not rely on the future to mirror the past, but rather uses historical experience to provide scenarios and associated probabilities to generate a forecast of performance.

Refer now to Figure 8, which shows a flow chart illustrating a computer implemented method 400 for generating data indicative of risk associated with a portfolio of financial service agreements in accordance with an exemplary embodiment of the present invention. Similar to the method 200 for generating data indicative of risk associated with an application for financial services as described with reference to Figures 2 through 7, the method 400 illustrated in Figure 8 includes the basic steps 320, 330 of generating of a series of discrete scenarios and generating a portfolio forecast based on the scenarios. Except as described herein, the basic steps 320, 330 of method 400 generally correspond to the basic steps 60, 70 of method 200. However, as will be appreciated from the discussion with reference to Figure 9, it is not necessary in process 330 to generate a performance curve as in process 70 because preexisting forecasts are utilized.

The step 320 of generating scenarios may be accomplished by sampling global data 106 for changes in global attributes as a function of time to thereby generate global sequences. Each global sequence has an intensity, an influence on the portfolio, and a probability of occurrence, which correlate to a magnitude, a direction and a probability of occurrence of each global scenario. These global sequences embody the overall framework or conditions under which the portfolio performance is to be evaluated.

Once the global portfolio scenarios have been generated, a portfolio forecast may be generated. The step of generating a portfolio forecast 330 is discussed in detail with reference to Figure 9. The generation of a portfolio forecast 330 begins by synchronizing 332 individual forecasts from the set of individual forecasts 360. The set of individual forecasts 360 comprises a forecast of performance 76 for each individual within the portfolio. The set of individual forecasts 360 may therefore be generated by collecting a forecast of performance 76 for each individual in the portfolio utilizing the methods discussed with reference to Figures 2 through 7.

The synchronization step 332 involves placing each forecast on the same time line in real time. Once synchronized, the individual forecasts are combined 334 using known combinatorial methods. The combined forecast may be referred to as an initial portfolio forecast which is a set of performance curves. Thus, an initial portfolio forecast is generated by synchronizing 332 and combining 334 the individual forecasts. The synchronizing 332 and combining 334 steps may be performed either before or after the scenario application step 336 described below.

The global portfolio scenarios as generated by step 320 may then be selectively applied 336 to the initial portfolio forecast at points in time based on the probability of occurrence of each discreet scenario at each point in time and based on the effect (if any) of the global scenarios to scenarios used in the individual forecasts. In other words, the global scenarios are selectively applied only to those individual forecasts that contain a scenario that will be influenced (e.g., dampened, amplified) by the particular global scenario. Thus, the energy or slope at each point in time on the initial portfolio forecast changes in an amount corresponding to the magnitude and direction of the discreet scenario applied thereto. The result is a modified portfolio performance curve.

The modified portfolio performance curve is then checked 338 for stability. Stability may be checked by assessing the convergence of the steady state conditions of various groups of loans. That is, if the variance of the number of applicants in a group is minimal or below an acceptable error rate, the group is considered stable. In terms of counting statistics, the stability check is equivalent to the need to take several measurements to assess the reliability of the underlying process.

If the modified portfolio performance curve is unstable, the scenario selection is modified 440 and the scenarios are reapplied 336. If the modified portfolio performance curve is stable, the performance curve comprises a forecast of portfolio performance 342. The forecast of portfolio performance 342 is indicative of risk associated with the particular portfolio under evaluation. Based on the portfolio forecast 342, the portfolio may be characterized or modified 350.

Portfolio characterization 350 is preferably based on portfolio characteristics during steady state conditions within the portfolio, and more preferably, at a steady state condition of the entire portfolio, i.e., the transient equilibrium point of the

portfolio. The stability check 338 discussed above provides the means by which these steady state conditions may be identified.

The identification of a steady state condition of the entire portfolio or a portion thereof is an important aspect of risk management using the forecasting method described herein. When several individual forecasts are synchronized and aged simultaneously, it is possible to get many steady states. The definition of a steady state is unique to each financial institution, but in general terms, it is when a high percentage of individual forecasts within the portfolio fall within some specified parameters of behavior. Transient equilibrium points are large steady state events where overall portfolio information or characteristics thereof may be reliably gathered.

The method 400 for generating data indicative of risk associated with a portfolio of financial service agreements as in the present invention is an improvement over prior art methods because factors influencing the performance of the portfolio, both internal and external, are applied over a finite timeline. The portfolio forecast allows the portfolio to be characterized and/or modified prior to gaining substantial experience with the portfolio.

Refer now to Figure 10, which illustrates a computer system 500 for generating data indicative of risk associated with an application for a financial service by an applicant and/or associated with a portfolio of financial service agreements. The computer system 500 may be any suitable data processing system including a processor 502, an input device 504, an output device 506, and a data storage means 508. The input device 504 generically refers to any means for providing data to the processor such as a keyboard or a telecommunications receiver. The output device 506 may comprise any suitable means to present the forecast 510 to the end user, and in particular the financial service institution. For example, the output device 506 may comprise a display, a printer, or a telecommunications transmitter. The data storage means 508 may comprise any means for temporarily or indefinitely storing data for use by the processor 502. For example, the data storage means 508 may comprise RAM or a disk drive. Those skilled in the art will recognize that many suitable alternatives for the generic components of the computer system 500 may be utilized without departing from the scope or spirit of the invention.

The computer system 500, and in particular the processor 502, may obtain data 100 from a credit bureau database 600 and/or a financial institution database 700. The data 100 may comprise applicant data, population data, and/or global data as discussed previously. Applicant data 102 may also be introduced into the processor 502 by way of the input device 504. Typically, such applicant data 102 will be obtained from the application form 800 and manually entered into the computer system 500 through the input device 504. However, the various means for providing data to the computer system 500 are merely illustrative.

The processor 502 of the computer system 500 performs the majority of the operations and steps discussed previously with regard to Figures 2 through 9. Specifically, the processor 502 provides means for generating a forecast, means for comparing the forecast to a risk threshold, means for generating a set of applicant, population, and/or global scenarios, means for generating an applicant or portfolio performance curve, means for modifying such a performance curve, means for sampling data, means for characterizing such data or subsets thereof, means for calculating probabilities associated with such data, means for calculating intensity associated with such data, means for correlating data, means for classifying data, means for matching data, etc. The output device 506 or an extension thereof provides means for accepting or rejecting an application and means for providing a forecast indicative of risk associated with a portfolio or a financial service application. The data storage means 508 provides means for storing applicant, population, and global data indicative of attributes thereof, and means for storing derivative data thereof such as sequences, scenarios, attributes, matched variables, performance curves, forecasts, etc.

As stated previously, the computer system 500 may be any suitable data processing system and may be utilized for generating data indicative of risk associated with both financial service applications and financial service agreement portfolios according to the methods 200, 400 described herein.

Thus, the present invention provides a system 500 and method 200 for generating data indicative of risk associated with an application for financial service by an applicant in addition to a system 500 and method 400 for generating data indicative of risk associated with a portfolio of financial service agreements. The

methods 200, 400 include and the system 500 implements the basic step of generating a forecast of performance of the applicant/portfolio wherein the forecast comprises a series of discreet scenarios applied over a finite timeline, using a template referred to as an aging strip. Such a forecast is indicative of risk and is tremendously useful data.

Those skilled in the art will recognize that the present invention may be manifested in a variety of forms other than the specific embodiments described and contemplated here. Accordingly, departures in form and detail may be made without departing from the scope and spirit of the present invention as described in the appended claims.

What is claimed is:

1. A computer implemented method for generating data indicative of risk associated with an application for a financial service by an applicant, the method comprising the step of;

generating a forecast of performance of the applicant, the forecast comprising a series of discrete scenarios, the forecast indicative of risk associated with the application.

2. A computer implemented method as in claim 1, further comprising the steps of:

comparing the forecast to a risk threshold; and

accepting the application if the forecast is greater than the risk threshold.

3. A computer implemented method as in claim 1, further comprising the steps of:

comparing the forecast to a risk threshold; and

rejecting the application if the forecast is less than the risk threshold.

4. A computer implemented method as in claim 1, further comprising the steps of:

providing applicant data indicative of attributes of the applicant; and

generating a set of applicant scenarios based on the attributes, each applicant scenario having a probability of occurrence and an effect on future performance of the applicant, wherein the series of discrete scenarios are selected from the set of applicant scenarios.

5. A computer implemented method as in claim 4, further comprising the steps of:

providing population data indicative of attributes of a plurality of financial service applicants within the population; and

generating a set of population scenarios based on matched applicant and population attributes, each population scenario having a probability of occurrence and

an effect on future performance of the applicant, wherein the series of discrete scenarios are selected from the set of applicant scenarios and the set of population scenarios.

6. A computer implemented method as in claim 5, further comprising the steps of:

providing global data indicative of global attributes affecting all applicants within the population; and

generating a set of global scenarios based on the global attributes, each global scenario having a probability of occurrence and an effect on future performance of the applicant, wherein the series of discrete scenarios are selected from the set of applicant scenarios. the set of population scenarios and the set of global scenarios.

7. A computer implemented method as in claim 1, the step of generating a forecast comprising the steps of:

generating an applicant performance curve comprising applicant energy as a function of time, the curve having an initial energy; and

modifying the performance curve by applying the series of discrete scenarios to the performance curve at points in time based on the probability of occurrence of each discrete scenario at each point in time, wherein the energy at each point in time changes in an amount corresponding to the magnitude and direction of the discrete scenario applied at each point in time to obtain a modified performance curve, the modified performance curve comprising the forecast of performance.

8. A computer implemented method as in claim 1, wherein a plurality of forecasts are generated including an optimistic forecast and a pessimistic forecast.

9. A computer implemented method as in claim 1, wherein a plurality of forecasts are generated including an optimistic forecast, a pessimistic forecast and a neutral forecast.

10. A computer implemented method as in claim 4, the step of generating applicant scenarios comprising the steps of:

sampling the applicant data for changes in the attributes as a function of time to generate applicant sequences;

characterizing each sequence as a positive, negative or neutral influence;

calculating a probability of occurrence for each sequence; and

calculating an intensity for each sequence;

wherein the magnitude, direction and probability of occurrence of each applicant scenario correlates to the intensity, influence and probability of occurrence of each applicant sequence, respectively.

11. A computer implemented method as in claim 5, the step of generating population scenarios comprising the steps of:

sampling the population data for changes of the attributes as a function of time to generate population sequences;

correlating the population sequences to successful loans and failed loans to generate population sequences having a positive influence and a negative influence, respectively;

calculating a probability of occurrence for each population sequence;

calculating an intensity for each population sequence;

sampling the population sequences for common patterns to generate stable population sequences;

classifying the stable population sequences based on association with class attributes of the population to generate classes of stable population sequences having class attributes; and

matching the class attributes to applicant attributes to generate matched population sequences applicable to the applicant;

wherein the magnitude, direction and probability of occurrence of each population scenario correlates to the intensity, influence and probability of occurrence of each matched population sequence, respectively.

12. A computer implemented method for generating data indicative of risk associated with a portfolio of financial service agreements, the method comprising the step of generating a portfolio forecast of performance of the portfolio, the portfolio forecast comprising a series of discrete scenarios, the portfolio forecast indicative of risk associated with the portfolio.

13. A computer implemented method as in claim 12, the method further comprising the steps of:

providing a set of individual forecasts of performance for each agreement or a class of agreements in the portfolio; and

applying the series of discrete scenarios to the set of individual forecasts to generate the portfolio forecast.

14. A computer implemented method as in claim 13, further comprising the steps of:

providing global data indicative of global attributes affecting all agreements within the portfolio; and

generating a set of global scenarios based on the global attributes, each global scenario having a probability of occurrence and an effect on future performance of the portfolio, wherein the series of discrete scenarios are selected from the set of global scenarios.

15. A computer implemented method as in claim 14, wherein the global data includes macro economic information.

16. A computer implemented method as in claim 15, wherein the global data includes financial institution information.

17. A computer implemented method as in claim 12, further comprising the steps of:

synchronizing the agreements within the portfolio as a function of time;

identifying steady state conditions within the portfolio; and

identifying portfolio characteristics at the steady state conditions.

18. A computer implemented method as in claim 12, further comprising the steps of:

synchronizing the agreements within the portfolio as a function of time;

identifying a steady state condition of the entire portfolio, the steady state condition comprising a transient equilibrium point; and

identifying portfolio characteristics at the transient equilibrium point.

19. A computer system for generating data indicative of risk associated with an application for a financial service by an applicant, the system comprising:

means for generating a forecast of performance of the applicant, the forecast comprising a series of discrete scenarios, the forecast indicative of risk associated with the application.

20. A computer system as in claim 19, further comprising:

means for comparing the forecast to a risk threshold, the comparing means coupled to the forecast generating means; and

means for accepting the application if the forecast is greater than the risk threshold, the accepting means coupled to the comparing means.

21. A computer system as in claim 19, further comprising:

means for comparing the forecast to a risk threshold, the comparing means coupled to the forecast generating means; and

means for rejecting the application if the forecast is less than the risk threshold, the rejecting means coupled to the comparing means.

22. A computer system as in claim 19, further comprising:

data storage means for storing applicant data indicative of attributes of the applicant, the applicant data storage means coupled to the forecast generating means; and

means for generating a set of applicant scenarios based on the attributes, each applicant scenario having a probability of occurrence and an effect on future performance of the applicant, wherein the series of discrete scenarios are selected from the set of applicant scenarios, the applicant scenario generating means coupled to the applicant data storage means.

23. A computer system as in claim 22, further comprising:

data storage means for storing population data indicative of attributes of a plurality of financial service applicants within the population, the population data storage means coupled to the forecast generating means; and

means for generating a set of population scenarios based on matched applicant and population attributes, each population scenario having a probability of occurrence and an effect on future performance of the applicant, wherein the series of discrete scenarios are selected from the set of applicant scenarios and the set of population scenarios, the population scenario generating means coupled to the comparing means.

24. A computer system as in claim 23, further comprising:

data storage means for storing global data indicative of global attributes affecting all applicants within the population, the global data storage means coupled to the forecast generating means; and

means for generating a set of global scenarios based on the global attributes, each global scenario having a probability of occurrence and an effect on future performance of the applicant, wherein the series of discrete scenarios are selected from the set of applicant scenarios, the set of population scenarios and the set of global scenarios, the global scenario generating means coupled to the global data storage means.

25. A computer system as in claim 19, the means for generating a forecast comprising:

means for generating an applicant performance curve comprising applicant energy as a function of time, the curve having an initial energy; and

means for modifying the performance curve by applying the series of discrete scenarios to the performance curve at points in time based on the probability of occurrence of each discrete scenario at each point in time, wherein the energy at each point in time changes in an amount corresponding to the magnitude and direction of the discrete scenario applied at each point in time to obtain a modified performance curve. the modified performance curve comprising the forecast of performance.

26. A computer system as in claim 22, the means for generating applicant scenarios comprising:

means for sampling the applicant data for changes in the attributes as a function of time to generate applicant sequences;

means for characterizing each sequence as a positive, negative or neutral influence;

means for calculating a probability of occurrence for each sequence;

means for calculating an intensity for each sequence; and

wherein the magnitude, direction and probability of occurrence of each applicant scenario correlates to the intensity, influence and probability of occurrence of each applicant sequence, respectively.

27. A computer system as in claim 23, the means for generating population scenarios comprising:

means for sampling the population data for changes of the attributes as a function of time to generate population sequences;

means for correlating the population sequences to successful loans and failed loans to generate population sequences having a positive influence and a negative influence, respectively;

means for calculating a probability of occurrence for each population sequence;

means for calculating an intensity for each population sequence;

means for sampling the population sequence for common patterns to generate stable population sequences;

means for classifying the stable population sequences based on association with class attributes of the population to generate classes of stable population sequences having class attributes; and

means for matching the class attributes to applicant attributes to generate matched population sequences applicable to the applicant;

wherein the magnitude, direction and probability of occurrence of each population scenario correlates to the intensity, influence and probability of occurrence of each matched population sequence, respectively.

28. A computer system for generating data indicative of risk associated with a portfolio of financial service agreements, the system comprising means for generating a portfolio forecast of performance of the portfolio, the portfolio forecast comprising a series of discrete scenarios, the portfolio forecast indicative of risk associated with the portfolio.

29. A computer system as in claim 28, further comprising:

means for generating a set of individual forecasts of performance for each agreement or a class of agreements in the portfolio, the individual forecast generating means coupled to the portfolio forecast generating means; and

means for applying the series of discrete scenarios to the set of individual forecasts to generate the portfolio forecast, the applying means coupled to the individual forecast generating means.

30. A computer system as in claim 29, further comprising:

data storage means for storing global data indicative of global attributes affecting all agreements within the portfolio, the data storage means coupled to the portfolio forecast generating means; and

means for generating a set of global scenarios based on the global attributes, each global scenario having a probability of occurrence and an effect on future performance of the portfolio, wherein the series of discrete scenarios are selected from the set of global scenarios, the global scenario generating means coupled to the global data storage means.

31. A computer system as in claim 28, further comprising:

means, coupled to the portfolio forecast generating means, for synchronizing the agreements within the portfolio as a function of time;

means, coupled to the synchronizing means, for identifying steady state conditions within the portfolio; and

means, coupled to the steady state identifying means, for identifying portfolio characteristics at the steady state conditions.

32. A computer system as in claim 28, further comprising:

means, coupled to the portfolio forecast generating means, for synchronizing the agreements within the portfolio as a function of time;

means, coupled to the synchronizing means, for identifying a steady state condition of the entire portfolio, the steady state condition comprising a transient equilibrium point; and

means, coupled to the steady state identifying means, for identifying portfolio characteristics at the transient equilibrium point.

PRIOR ART

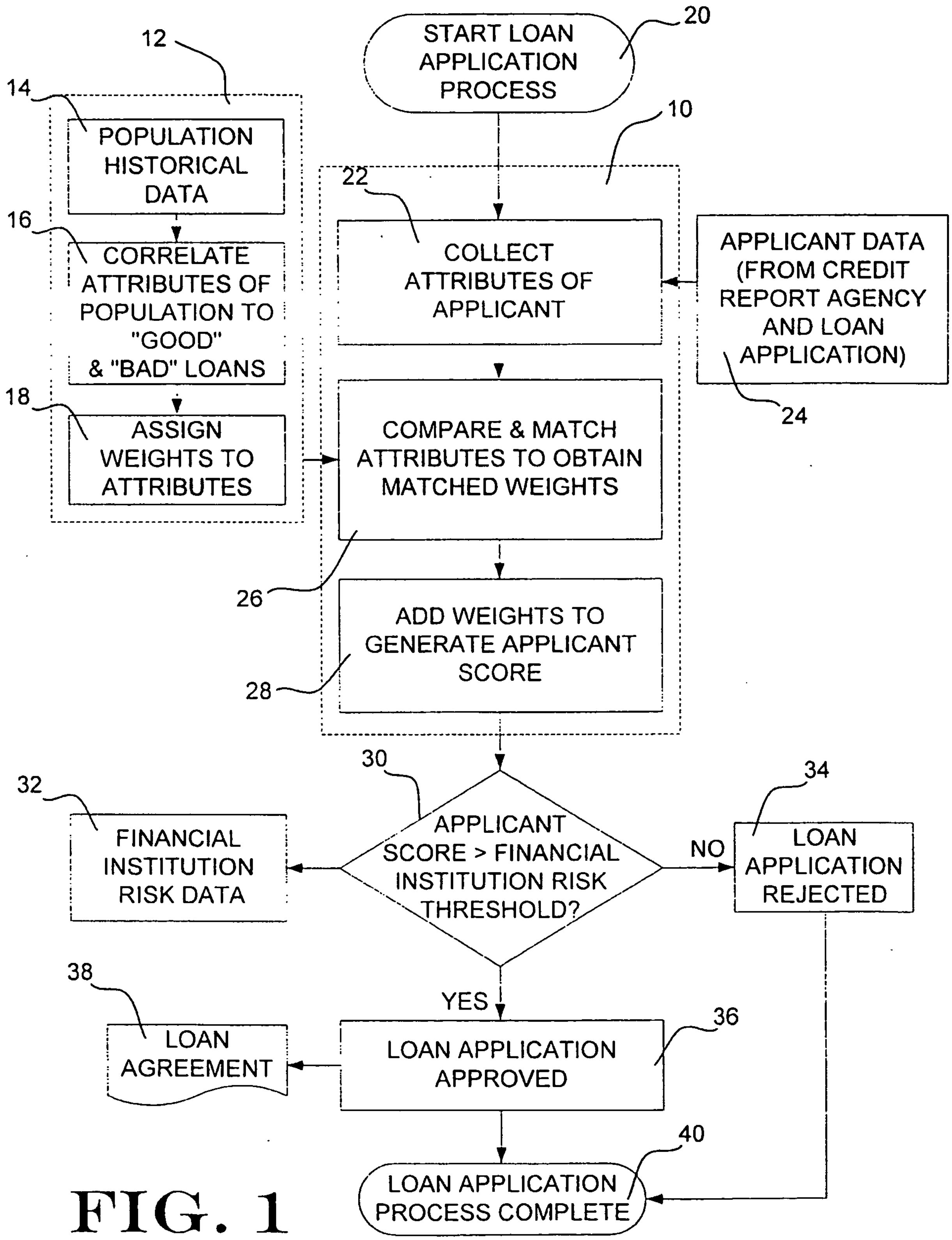
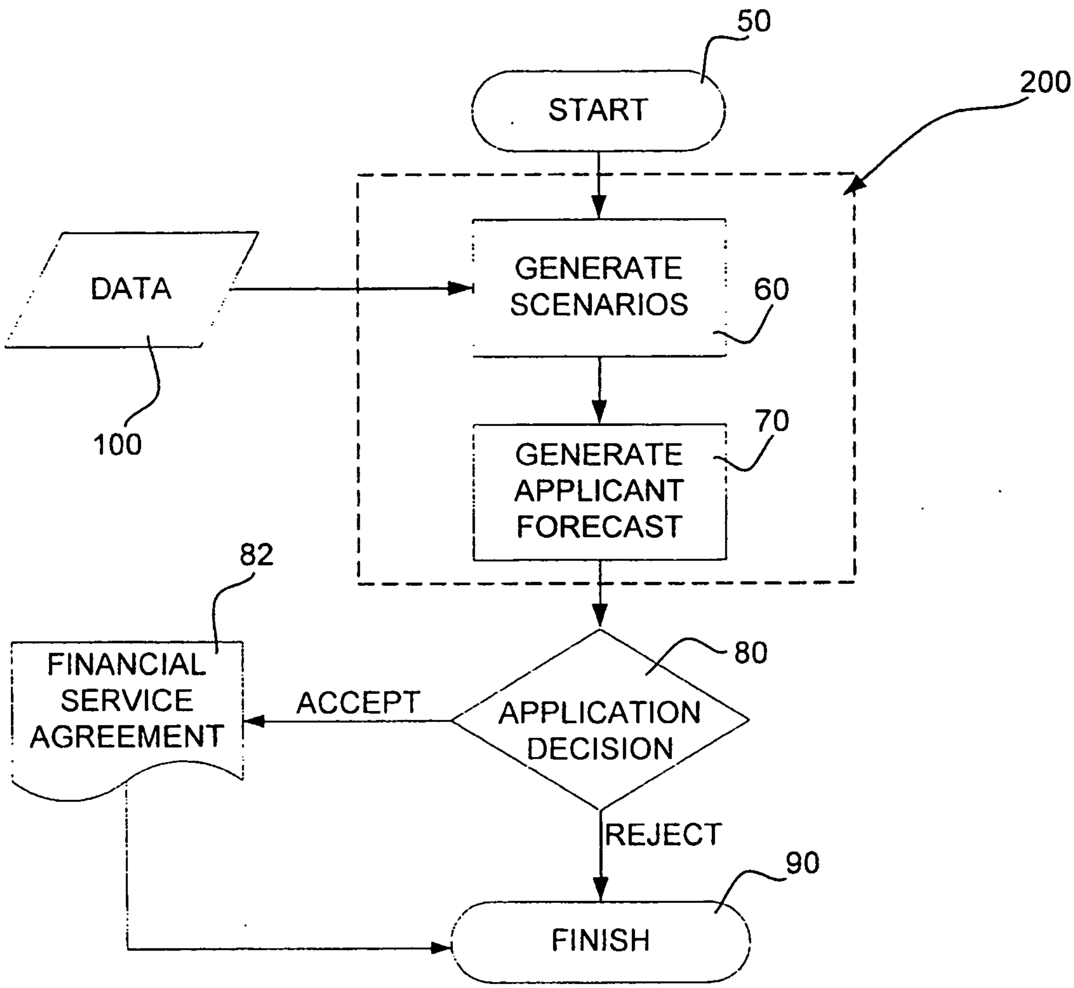


FIG. 1



50
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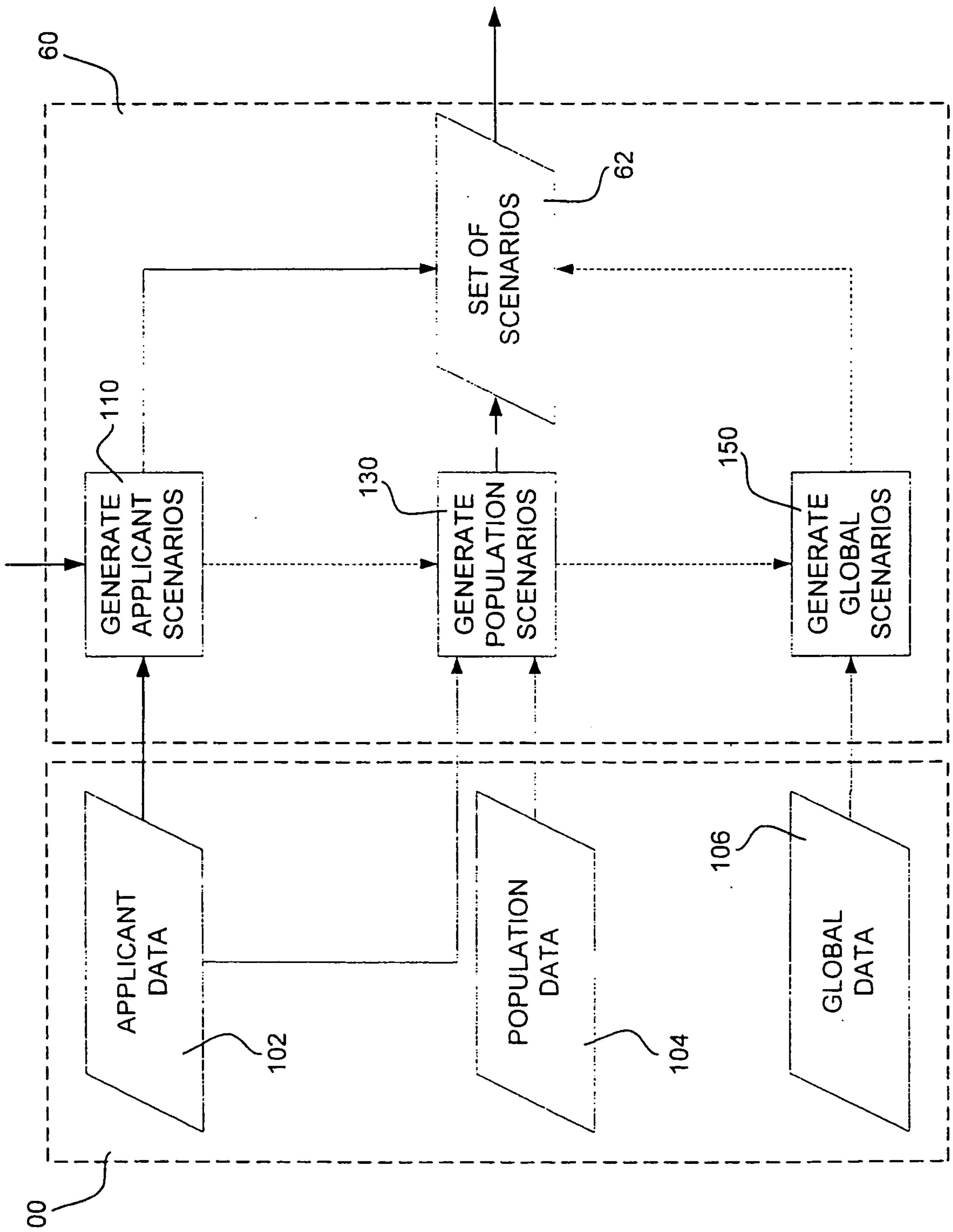
60
100
GENERATE APPLICANT FORECAST
70
82
FINANCIAL SERVICE AGREEMENT
ACCEPT
APPLICATION DECISION
80
REJECT
90
FINISH

FIG. 2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GENERATE APPLICANT SCENARIOS
110
GENERATE POPULATION SCENARIOS
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APPLICANT DATA
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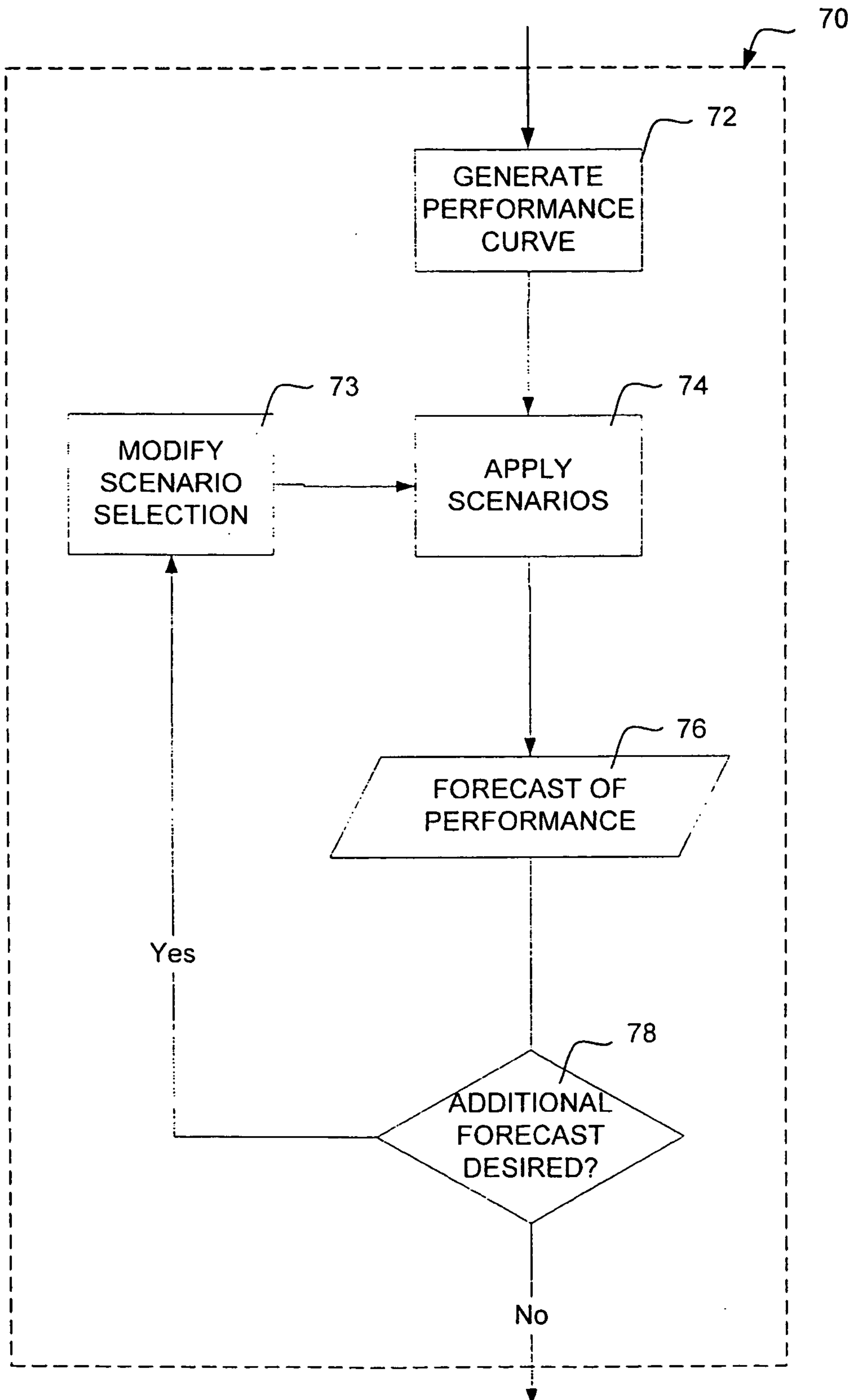
POPULATION DATA
104
GLOBAL DATA
106
100

FIG. 3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GENERATE PERFORMANCE CURVE
72
MODIFY SCENARIO SELECTION
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APPLY SCENARIOS
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FORECAST OF PERFORMANCE
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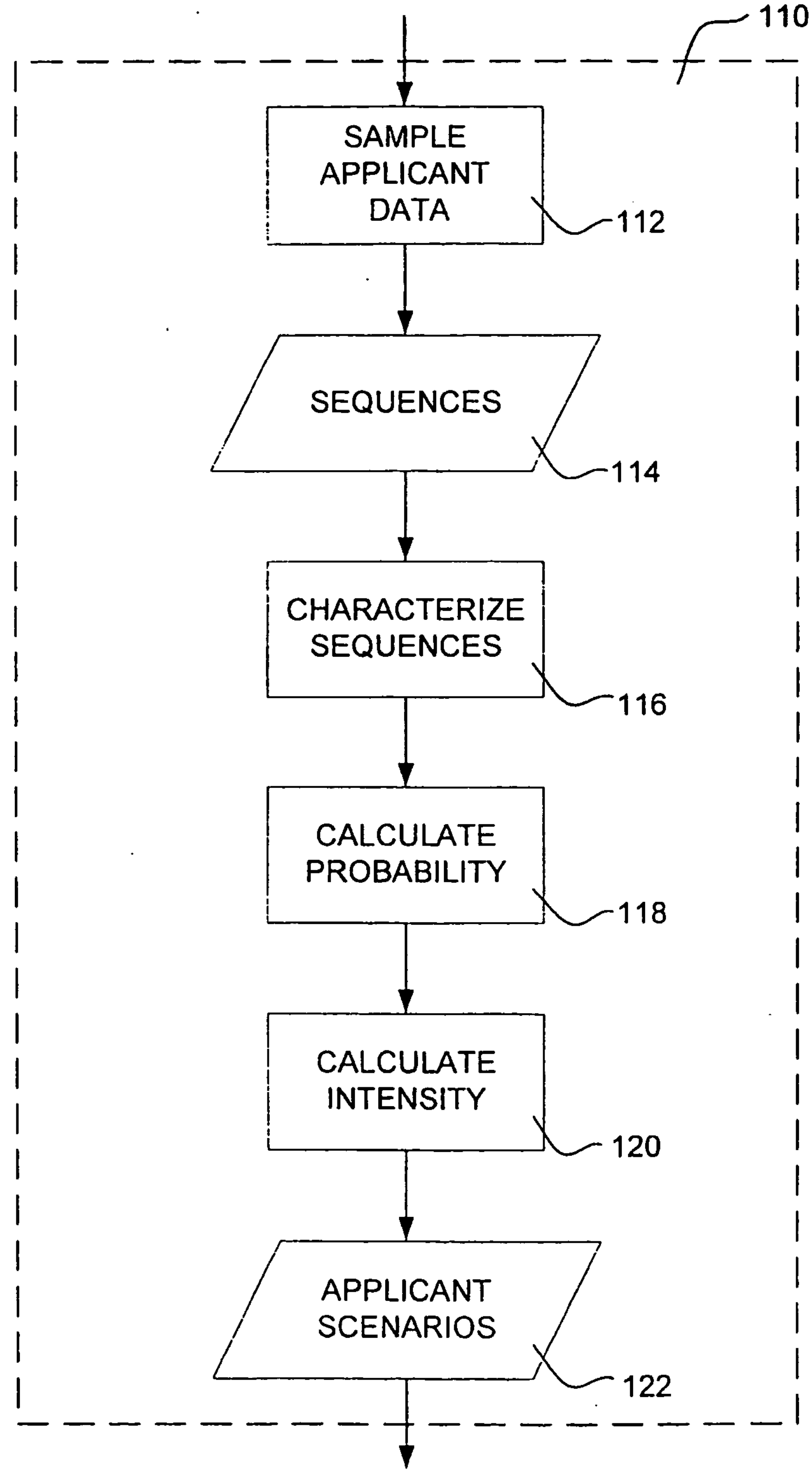
Yes
ADDITIONAL FORECAST DESIRED?
78
No

FIG. 4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112
SEQUENCES
114
CHARACTERIZE SEQUENCES
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CALCULATE PROBABILITY
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CALCULATE INTENSITY
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APPLICANT SCENARIOS
122

FIG. 5

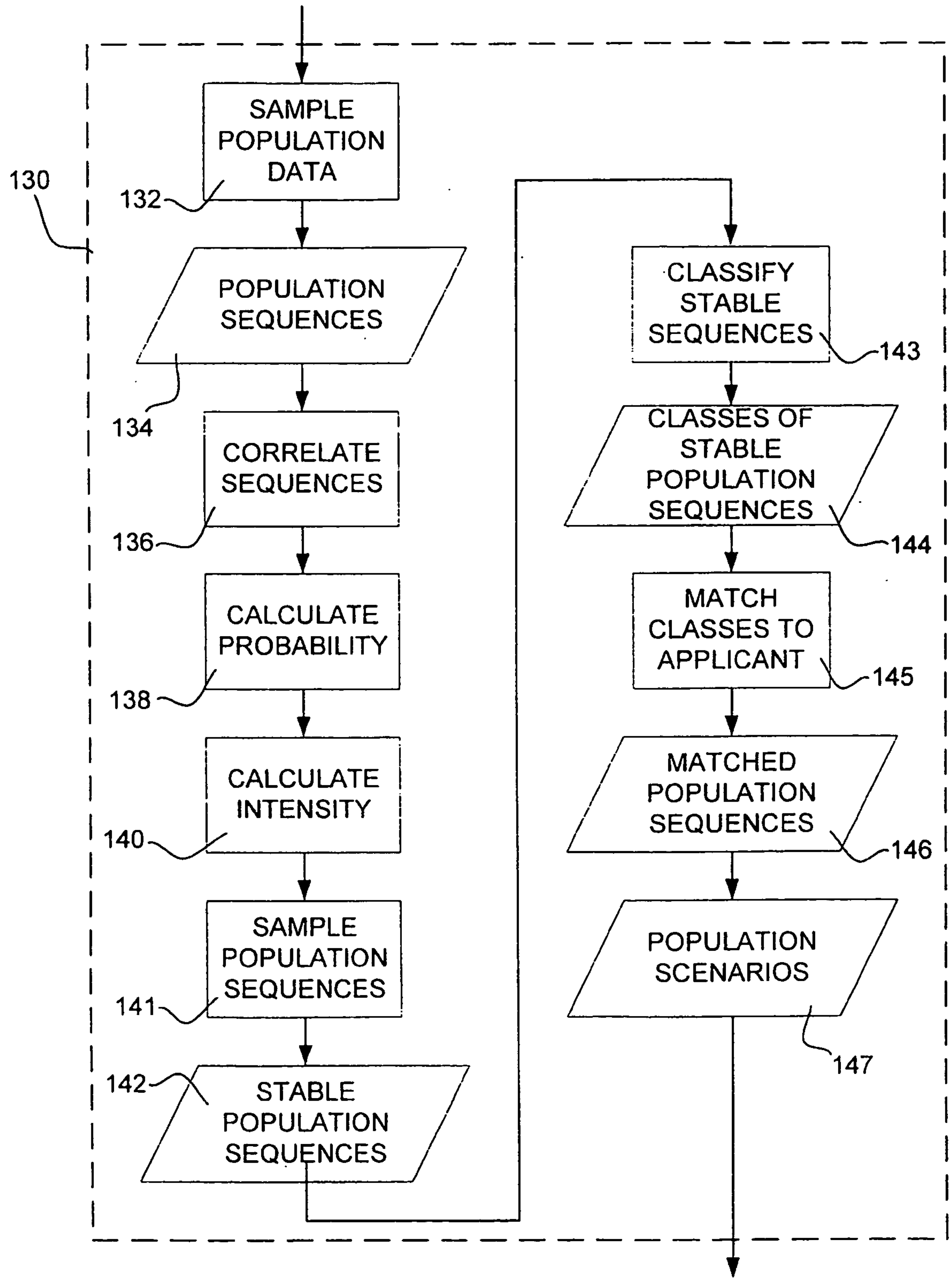

SAMPLE POPULATION DATA
132
130
POPULATION SEQUENCES
134
CORRELATE SEQUENCES
136
CALCULATE PROBABILITY
138
CALCULATE INTENSITY
140
SAMPLE POPULATION SEQUENCES
141
142
STABLE POPULATION SEQUENCES
CLASSIFY STABLE SEQUENCES
143
CLASSES OF STABLE POPULATION SEQUENCES
144
MATCH CLASSES TO APPLICANT
145
MATCHED POPULATION SEQUENCES
146
POPULATION SCENARIOS
147

FIG. 6

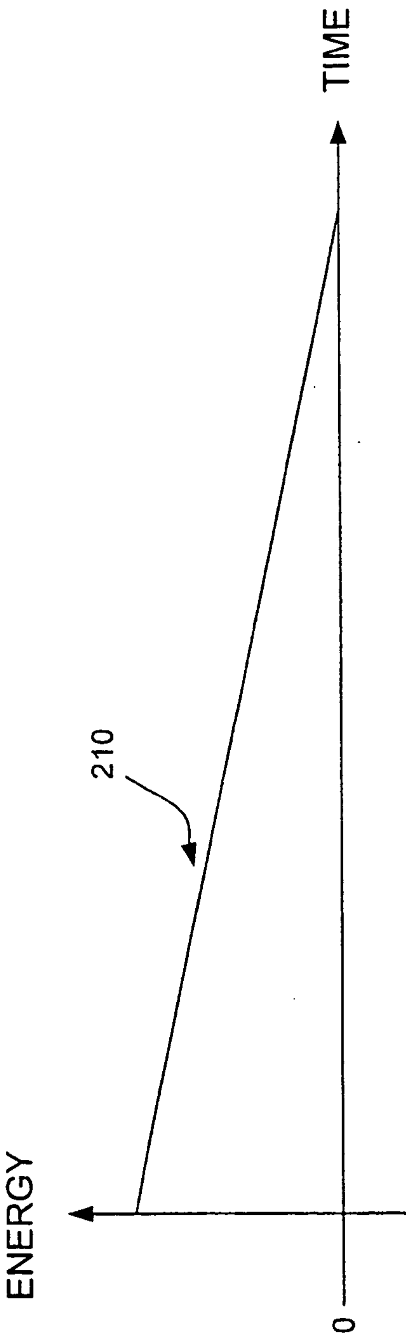


FIG. 7A

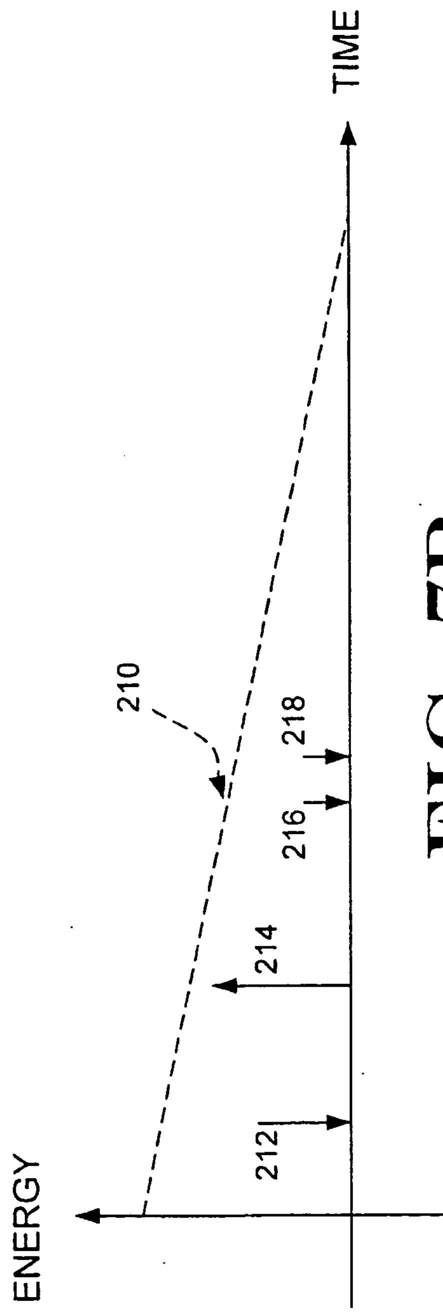


FIG. 7B

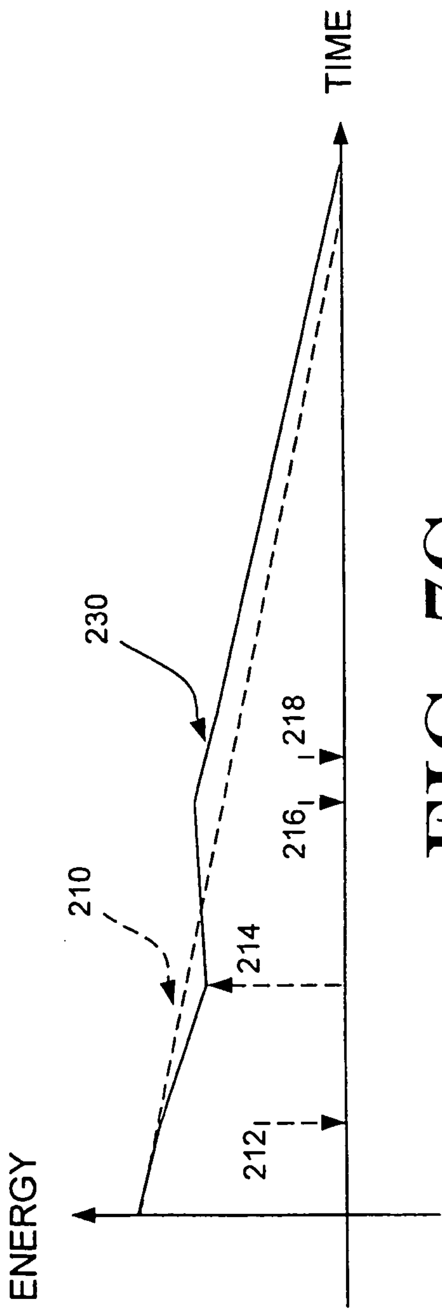


FIG. 7C

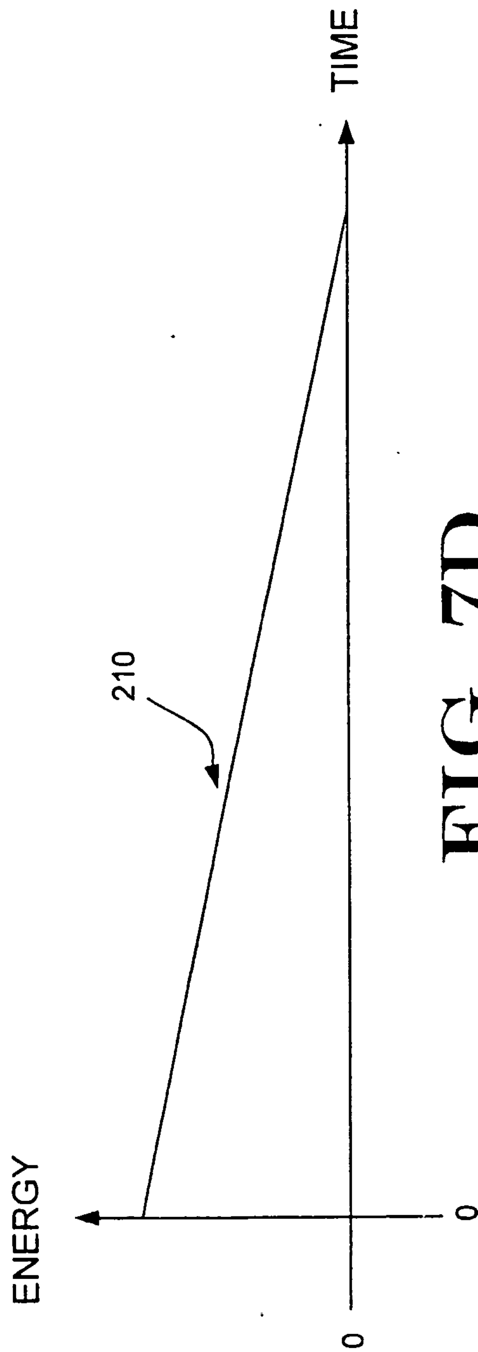
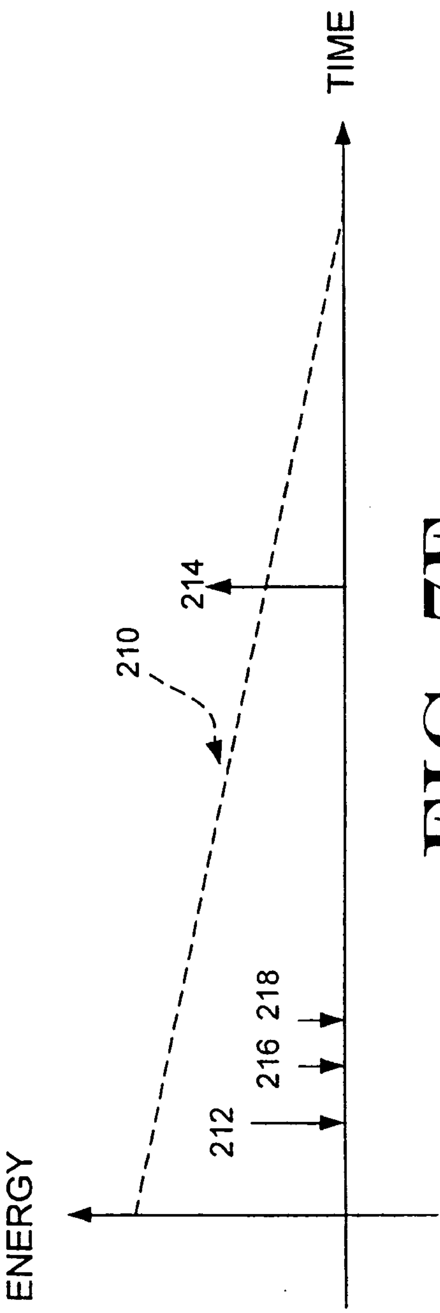
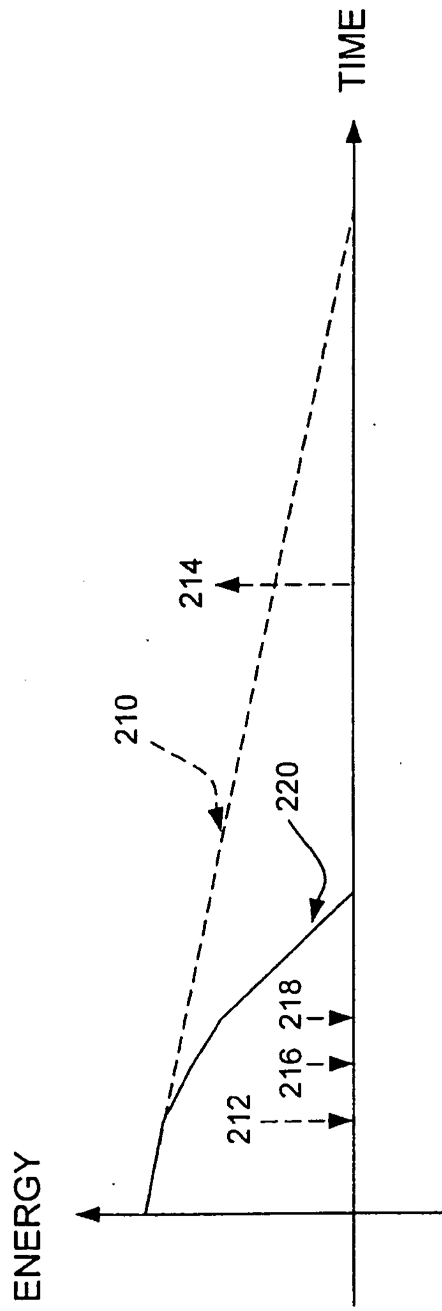


FIG. 7D



ENERGY
TIME
210
212
214
216
218

FIG. 7E



ENERGY
TIME
210
212
214
216
218
220

FIG. 7F

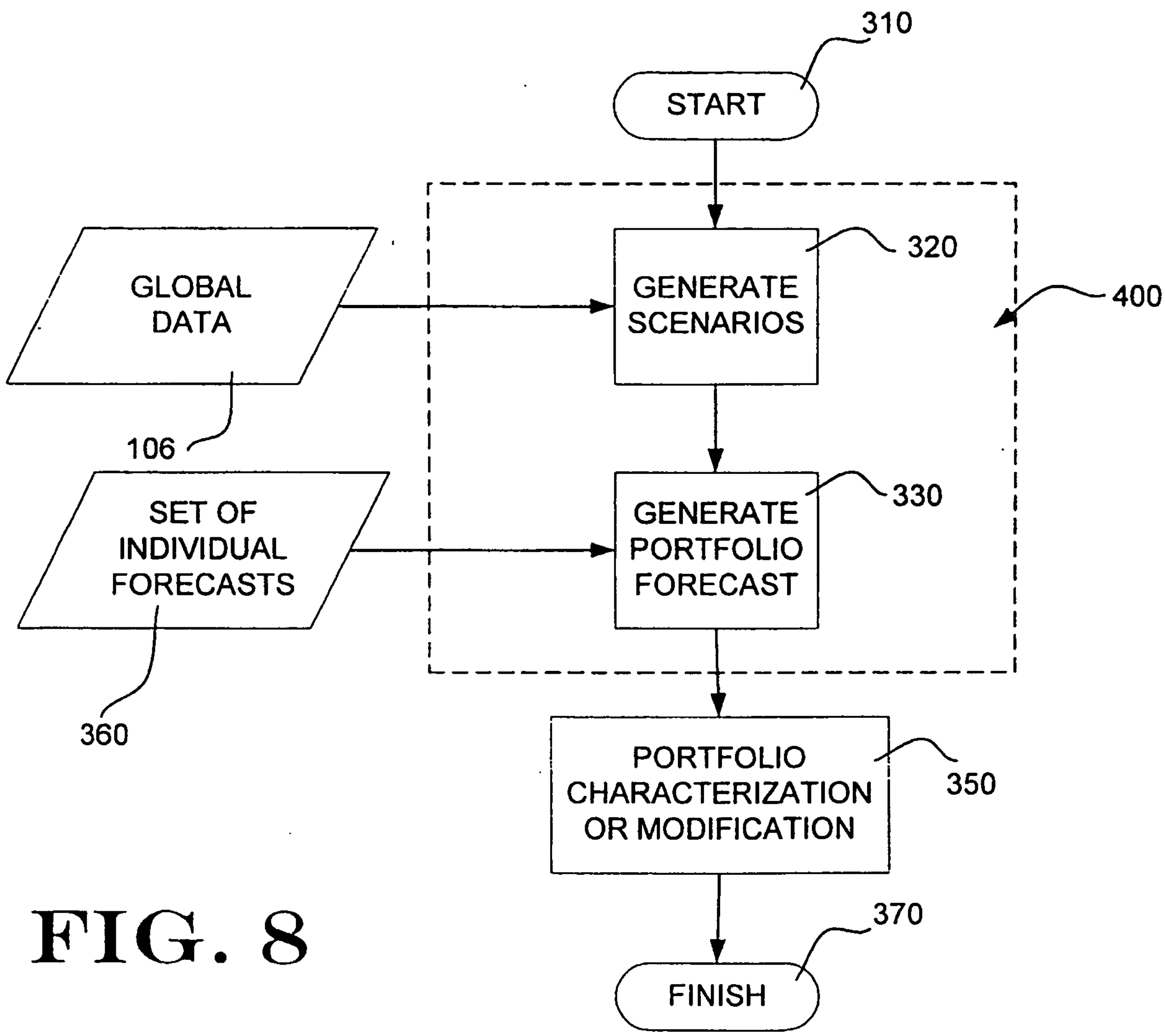

310
START
320
GENERATE SCENARIOS
400
GLOBAL DATA
106
SET OF INDIVIDUAL FORECASTS
330
GENERATE PORTFOLIO FORECAST
360
PORTFOLIO CHARACTERIZATION OR MODIFICATION
350
370
FINISH

FIG. 8

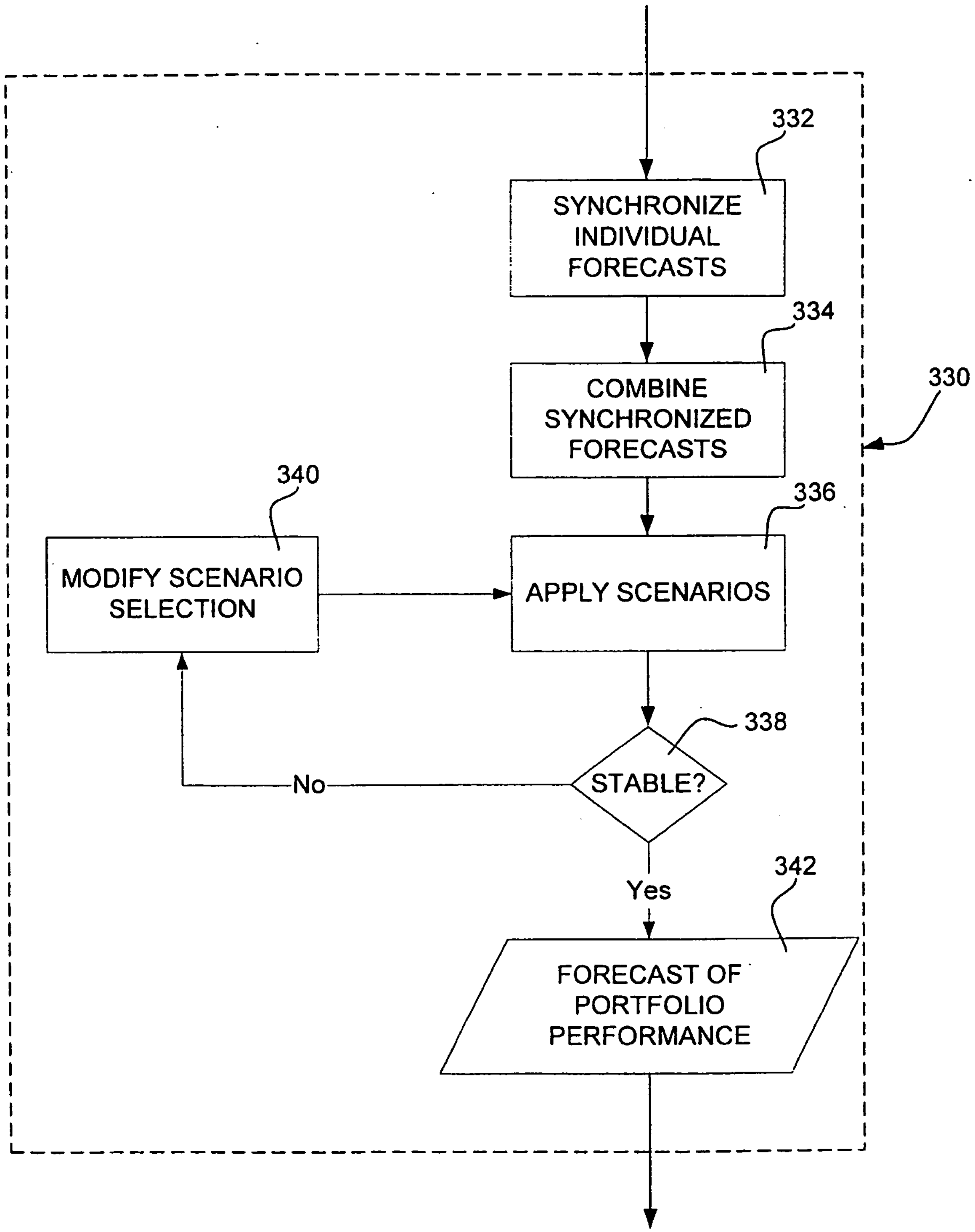

332
SYNCHRONIZE INDIVIDUAL FORECASTS
334
COMBINE SYNCHRONIZED FORECASTS
330
340
MODIFY SCENARIO SELECTION
336
APPLY SCENARIOS
338
STABLE?
No
Yes
342
FORECAST OF PORTFOLIO PERFORMANCE

FIG. 9

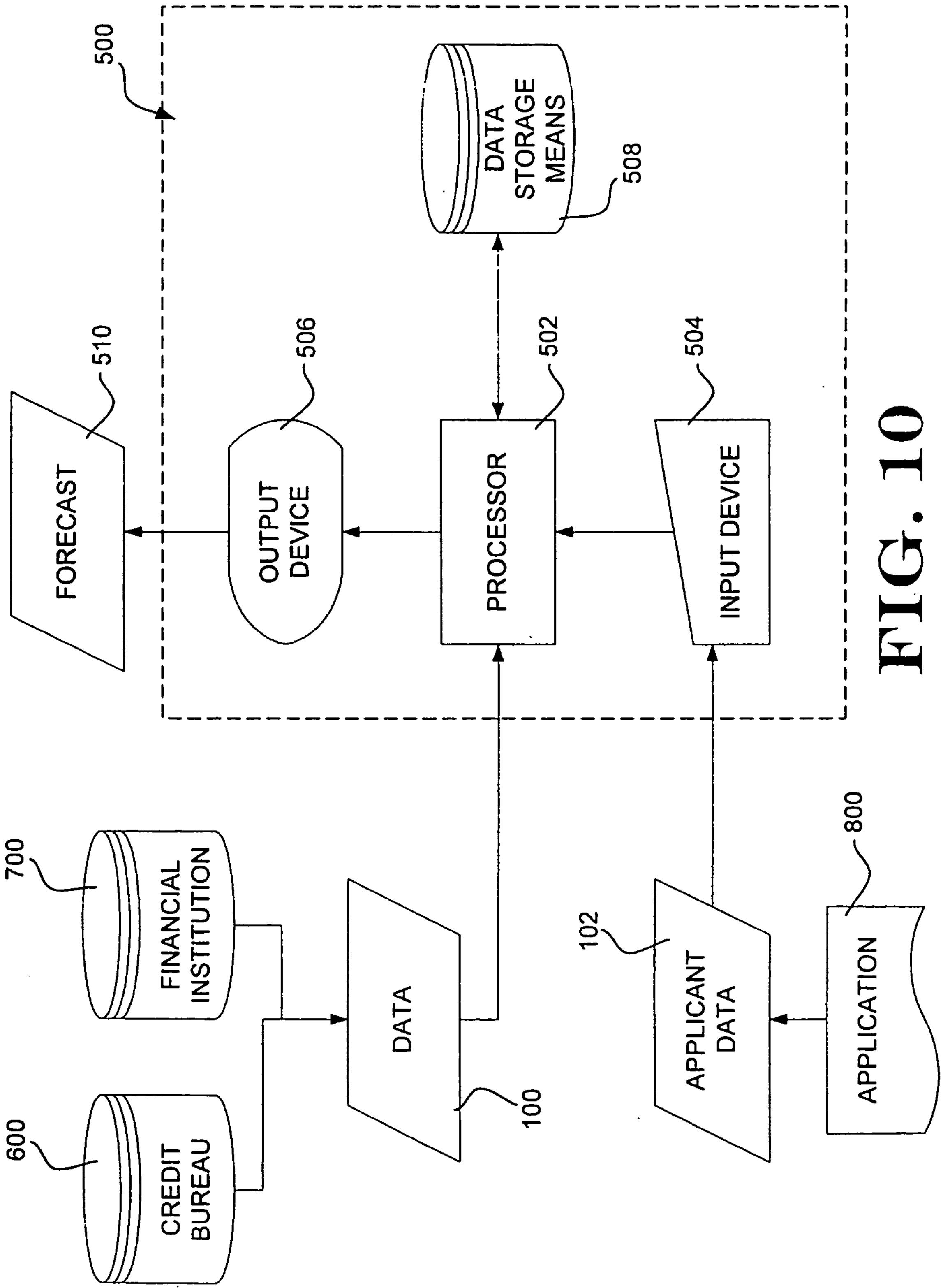

500
DATA STORAGE MEANS
508
FORECAST
510
OUTPUT DEVICE
506
PROCESSOR
502
INPUT DEVICE
504
700
FINANCIAL INSTITUTION
600
CREDIT BUREAU
DATA
100
102
APPLICANT DATA
800
APPLICATION

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/06186

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G06F 17/30
US CL :705/10, 35, 36, 38
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/10, 35, 36, 38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,975,840 A (DETORE et al.) 04 December 1990, All.	1-32
Y	US 5,812,988 A (SANDRETTO) 22 September 1998, All.	1-32
Y	US 5,809,478 A (GRECO et al.) 15 September 1998, All.	1-32.
Y	US 5,797,133 A (JONES et al.) 18 August 1998 , All.	1-32
Y,E	US 6,078,901 A (CHING) 20 June 2000, All.	1-32
Y,P	US 5,970,479 A (SHEPHERD) 19 October 1999, All.	1-32

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 18 JULY 2000	Date of mailing of the international search report 03 AUG 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer TODD EMMANUAL VOELTZ Eugenia Logan Telephone No. (703) 305-3900

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,611,052 A (DYKSTRA et al.) 11 March 1997 (11.03.97), All.	1-32